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A STUDY TO DETERMINE THE EVOLUTION OF ADVANCES IN MEDICAL TECHN--ETC(U)

A STUDY TO DETERMINE THE EVOLUTION OF  
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DOT-CG-906760-A

448-103-05/04

USCG-D-40-80-APP-C

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Report 448-103-05/04

AD A090012

APPENDIX-C

RESULTS OF THE WORKSHOP.

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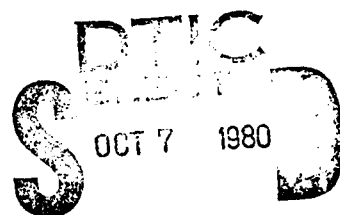
Final rept. Apr 79-May 80

DET CG-9067000



May 1980

FINAL REPORT



Document is available to the U.S. public through the  
National Technical Information Service  
Springfield, Virginia 22161

PREPARED FOR

U.S. DEPARTMENT OF TRANSPORTATION  
United States Coast Guard  
Washington, DC 20590

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## RESULTS OF THE WORKSHOP

✓  
This appendix contains judgments provided by Coast Guard medical personnel during a one-day workshop which was designed to review the importance of varied technologies. The column labeled "Impact" provides group judgments on a scale of 0-10, where 0 means "no impact" on the Coast Guard and 10 means "very important." Under the "Missions" columns similar data are included. However, in this case, the numbers indicate the number of people who chose the development as relevant to the particular mission shown.

At the bottom of each page the italics indicate developments suggested by the attending personnel.

A

PREVENTIVE TECHNOLOGIES	IMPACT	MISSIONS									
		OPERATIONAL					SUPPORT				
		ELT	TO	NEH	MO/	PSS	SAR	CVS	GAK	GAI	GAP
				NP							
1 Mass health evaluation procedures discontinued.	5.9	1		6	3	5	3	6	1	6	
Refinement of health hazard assessment technologies	5.8	1	2	3	1	1	3	4	1	4	
Manipulation of the physical and social environment	5.2	1	1	2	1	1	2	3	1	5	
Psychological factors (morale building) in health maintenance.	4.6	1	1	1	1	1	1	3	1	3	
Health education employs behavior modification techniques.	4.2							3		2	
2 Matching of induction medical evaluation parameters of personnel to billet requirements.	3.2	4	4	4	4	4	4	4	4	4	
3 New control measures for common viral and bacterial diseases.	3.0			2				4		1	
Decrease in venereal disease as more women enter service.	1.6			1				2	1	1	
1 If mass medical society says this is proper, CG will want to conform.											
2 Recruiting retention level impacted. It's new, something we don't do.											
3 Not a "biggie"--we'd crank it in.											

THERAPEUTIC AND REHABILITATIVE TECHNOLOGIES (PROCEDURES)	Pb AGT	MISSIONS									
		OPERATIONAL					SUPPORT				
		ELT	IO	MEH	MO/ MP	PSS	SAR	CVS	GAK	GAI	GAP
Treatment with heat energy to destroy cancer tissues.	2.3								6		5
Use of easily administered adhesives to stop severe life-threatening hemorrhage.	7.5				1	1	3	2	6		2
<sup>2</sup> Availability of new skin grafting technique for burn treatment.	4.0				1	1	2		6		3
Availability of computer-controlled parenteral fluid dosing system for burn patients.	2.2				1		1	1	4		1
<sup>3</sup> Availability of inexpensive, reliable, implantable insulin and sensor infusion systems.	4.3				1			2	5		3
Availability of islet implantation techniques with five or ten year duration.	2.7				1			2	5		3
Availability of more sophisticated devices to relieve pain.	3.5							1	4		1
Widespread use of reinfusion of cryopreserved bone marrow.	1.7								5		2
Availability of effective safe alternative female contraceptives.	3.0								6		4
<sup>4</sup> Availability of site-specific drug delivery systems.	2.9								5		1
<sup>1</sup> Angiography = hospital procedure, not EMT.											
<sup>2</sup> Description this morning mentioned barrier dressings ---could have first aid applications.											
<sup>3</sup> Monitoring of merchant seamen: Fair share of diabetics--could be retained.											
<sup>4</sup> Could change mix of CG drugs and equipment carried on SAR missions and helicopters.											

THERAPEUTIC AND REHABILITATIVE TECHNOLOGIES (DRUGS)	IMPACT	MISSIONS									
		OPERATIONAL					SUPPORT				
		ELI	IO	MEH	MO/MP	PSS	SAR	CVS	GAK	GAI	GAP
1 Availability of anti-bacterial vaccines.	3.5				3	1	1	1	5		3
Availability of a treatment to inhibit beta-lactamase.	3.9				1			1	4		1
Availability of vaccines against diarrhea.	3.4		1		1			1	4		4
Availability of oral agents to enhance natural secretion of insulin.	3.1				1			1	4		4
Availability of vaccines to prevent juvenile-onset diabetes.	3.2				1			1	4		4
Availability of synthetic beta-endorphins or endorphin-inducers for analgesia.	3.8				2			1	4		3
Availability of oral agent to produce temporary male sterility.	4.0							1	2		3
2 Availability of effective agents to prevent allergic reactions.	5.2		1		1			1	4		3
3 Availability of effective anti-viral drugs.	4.8		1		1			1	4		3
Availability of prostaglandin-based drugs.	2.8				1			1	4		1
1 Economic importance--cheaper than antibiotics.											
2 Increases pool of available resources.											
3 Time on job.											

ORGANIZATIONAL TECHNOLOGIES	ACT	MISSIONS									
		OPERATIONAL					SUPPORT				
		ELI	IO	MEI	MO/MP	PSS	SAR	CVS	GAK	GAT	GAP
Increasing computer applications to a variety of diagnostic activities.	7.2		2	2	3		3	1	6	1	4
Remote health care via telecommunications.	7.3		1	1	3		4	2	6		3
1The use of physician extenders.	6.2	1	2	2	4	1	4	2	5	1	5
2Emergency medicine recognized as a specialty throughout society.	4.2			1	2	1	5	2	5		3
Legal definition of medical profession changed and broadened to include new lifestyle subspecialties.	3.5	1	1	1	2		2		5		5
Medical services to retired persons part of standard retirement package, contingent on suitable lifestyle.	4.9			1	2	1	1		6		5
Large organized health service consumer groups have powerful political influence.	4.6	1		1	3		1		4		4
Health and survival differences between U.S. and other countries an important international issue.	2.6	1		2	2		2		4		4
3Floating laboratories and emergency water treatment facilities plus air mobile labs for disaster response with remote telemetry.	6.3	1		5	5	1	2		5		2
1Biomedical repair technicians.											
2CG already has. Society will recognize emergency physician--CG will be training civilians.											
3More disaster relief requirements on CG--Strike team programs--Soon will be required for hazardous spills.											

SUPPORTIVE TECHNOLOGIES	ACT	MISSIONS									
		OPERATIONAL					SUPPORT				
		ELT	IO	MEI	MO/MP	PSS	SAR	CVS	GAK	GAI	GAP
Regimens for life-expectancy prolongation and aging retardation.	3.9	2	2	2	3	2	2	2	3	2	4
Compulsory periodic reexamination and relicensing of physicians, other medical and paramedical personnel.	5.8				1				3		2
Widespread dissemination of biomedical information through elementary schools, mass media, etc.	3.1								3		3
Drugs that enhance powers of concentration, memory, learning.	4.9	1	2	2	2	2	2	2	3	2	4
Delaney Amendment modified to consider balance of costs and benefits of foods and drugs.	3.3								4		2
Drugs that control motivation, emotion.	4.9		1	1	2		1	1	4		4
Space technology and automation make feasible prostheses bypassing neural, muscular disabilities.	4.2			2	1		2				
Automated display of actuarial (frequency) data for diagnoses, etc. of cases with similar symptoms.	4.7								3		1
Equipment for ongoing noninvasive monitoring of normal biological processes.	4.0								3		1
Ongoing real time updating of all personnel medical records.	7.1				1				4	1	4
1 Federal mandate: Management Information System will be required in five years.											





## DIAGNOSTIC TECHNOLOGIES

1. Design of an automated system to test the effectiveness of various antibiotic agents against microorganisms.
2. Development of a method for producing an image of chemical events deep in the body.
3. Research examining the metabolite patterns of a group of specific disease states.
4. Availability of methods to identify subclinical or recurrent cancers.
5. Development of techniques that show promise in the detection of early precancerous lesions of the cervix.
6. Availability of a procedure for detecting cardiac muscle destruction.
7. Ability to transmit medically relevant signals from a patient over long distances.
8. Ability to interface a long-distance transmitter with a computer programmed to carry out specific analyses of biomedical significance.
9. Development of a technique for analyzing constituents of blood without having to take samples from patient.
10. Availability of more specific measurements of burn severity.
11. Availability of a small electronic sensor to measure potassium levels continually.

D1. DESIGN OF AN AUTOMATED SYSTEM TO TEST THE EFFECTIVENESS OF VARIOUS ANTIBIOTIC AGENTS AGAINST MICROORGANISMS.

- Electrooptical scanning system repeatedly monitors microbial growth in the presence of various antibiotics.
- Provides the following information
  - identifies one or more antibiotics which will halt the growth of the organism causing the infection
  - identifies the nature of the infection and the bacteria causing the problem within five hours
  - distinguishes between positive and negative urine specimens
  - provides a quantitative index of pathogenic organisms susceptibility to one or more antibiotics
- Advantages over existing methods
  - tests 10 antibiotics in 3-6 hours
  - initiation of therapy up to 18 hours sooner saving lives and shortening hospital stay
- Applications
  - applicable to most types of bacterial infections
- Future extension of basic principle?

D2. DEVELOPMENT OF A METHOD FOR PRODUCING AN IMAGE OF CHEMICAL EVENTS DEEP IN THE BODY.

- Principle--Nuclear magnetic resonance signals emanating from a living body are converted into visual images which represent certain specifiable chemical events occurring deep in the body

- Future applications?

- differentiating tumors from normal tissue
- identification of water-related, congenital abnormalities such as: a) hydrocephalous, b) abscesses, c) vascular abnormalities, and d) brain swelling
- NMR signals can be used to detect pH changes in various organs; i.e., in heart during cardiac arrest
- determination of suitability of organs for transplantation
- detection of changes in the water content in tissues; i.e., in a) inflammations, b) fluid filled cysts, c) ischemia, and d) bloodflow

D3. RESEARCH EXAMINING THE METABOLITE PATTERNS OF A GROUP OF SPECIFIC DISEASE STATES.

- Purpose--to create a system of diagnostic testing procedures
- Method--mass spectrometry
- Principle--sorting out of patterns of elevated or depressed levels among the body's more than 1000 metabolites and relating these patterns to known, preexisting pathological entities
- Future extension of basic principle?

DA. AVAILABILITY OF METHODS TO IDENTIFY SUBCLINICAL OR RECURRENT CANCERS.

- serum thyroglobin: marker for recurrent cancer in thyroid patients
- thyrocalcitonin quantities increase in medullary thyroid carcinoma
- increased blood levels of carcinoembryonic antigen for recurrent colon cancer
- Clostridium butyricum (an anaerobic bacterium) spores injected; in 1 to 3 weeks, specific serum antibodies signal the presence of cancer (which can then be located with isotope-labeled antibodies).
- choriocarcinoma and various testicular cancers produce human chorionic gonadotropin (HCG)
- increased levels of galactosyltransferase may indicate malignant breast or intestinal neoplasms.
- Hemocult II (SmithKline), a modified guaiac test for occult blood in the stool became available recently to detect colorectal cancer while still asymptomatic.
- radioimmunoassay for galactosyltransferase isoenzyme II, which appears in the serum of individuals with malignant disease but not in normal subjects.
- pleomorphic microvilli on cell surfaces in urine specimens from bladder cancer patients are distinguishable with scanning electronic microscope.

D5. DEVELOPMENT OF TECHNIQUES THAT SHOW PROMISE IN THE DETECTION OF EARLY  
PRECANCEROUS LESIONS OF THE CERVIX.

- Principle--histophysiologic diffusion gradient culture,  
discriminates precancerous from normal cells by their  
differential rates of diffusion along a gradient in  
culture
- Method--a collagen membrane attached to a cellulose  
sponge furnishes the growth medium and diffusion  
substrate
- Future implications?

D6. AVAILABILITY OF A PROCEDURE FOR DETECTING CARDIAC MUSCLE DESTRUCTION.

- Purpose--to diagnose myocardial infarctions
- Principle--quantification by radioimmunoassay of the concentration of creatine kinase MB isoenzyme released by heart muscle during heart attacks into blood serum of individuals believed to have had infarction
- Advantages
  - thousands of times more sensitive than preexisting methods for detecting cardiac muscle destruction
  - detectable within two hours of the onset of chest pain
- Future implications?



D7. ABILITY TO TRANSMIT MEDICALLY RELEVANT SIGNALS FROM A PATIENT OVER LONG DISTANCES.

- Principle--telemetry
- Procedure
  - patient connected to sensor or sensors
  - sensors capable of monitoring a variety of physiological and biochemical events
  - signals from individual events transduced
  - transduced signals transmitted over long distances
- Application
  - cardiovascular
  - endocrinological
  - respiratory
  - musculoskeletal
  - neurological
  - biochemical
- Future implications?

D8. ABILITY TO INTERFACE A LONG DISTANCE TRANSMITTER WITH A COMPUTER PROGRAMMED TO CARRY OUT SPECIFIC ANALYSES OF BIOMEDICAL SIGNIFICANCE

- Principle--telemetry units connected on-line to computers

- Procedure

- signals from patient enter computer directly
- computer performs programmed operations on data immediately
- computer components display results of operations on information received

- Application

- cardiovascular
- endocrinological
- respiratory
- musculoskeletal
- neurological
- biochemical

- Future implications?

D9. DEVELOPMENT OF A TECHNIQUE FOR ANALYZING CONSTITUENTS OF BLOOD WITHOUT HAVING TO TAKE SAMPLES FROM PATIENT.

- Principle--infrared spectroscopy indicates the concentrations of substances in the blood by the amount of component electromagnetic energy absorbed
- Method--laser light is passed through the lip of a patient. A given component of the electromagnetic spectrum, corresponding to the substance being analyzed is measured to determine how much of it was absorbed. The higher the concentration of the substance, the more of its IR component of radiation it absorbs.
- Applications--determines blood concentrations of a) ethanol, b) glucose, c) cholesterol, and d) uric acid
- Future implications?

D10. AVAILABILITY OF MORE SPECIFIC MEASUREMENTS OF BURN SEVERITY.

- Ultrasound distinguishes between burn types, depth, degree of severity
- replaces observation methods which can take weeks; allows faster initiation of therapy
- prototype device to be available soon.
- financed under ERDA grant to Oak Ridge National Laboratory.

D11. AVAILABILITY OF A SMALL ELECTRONIC SENSOR TO MEASURE POTASSIUM LEVELS CONTINUALLY

- especially useful in patients undergoing surgery, dialysis, or burn therapy
- solid state sensors provide instantaneous and continuous reading on body levels of K
- similar sensors may be added: sodium, calcium, magnesium
- University of Utah, NIH Grant

#### PREVENTIVE TECHNOLOGIES

1. Mass health evaluation procedures discontinued.
2. Refinement of health hazard assessment technologies.
3. Manipulation of the physical and social environment.
4. Psychological factors (morale building) in health maintenance.
5. Health education employs behavior modification techniques.
6. Matching of induction medical evaluation parameters of personnel to billet requirements.
7. New control measures for common viral and bacterial diseases.
8. Decrease in venereal disease as more women enter service.

P1. MASS HEALTH EVALUATION PROCEDURES DISCONTINUED

- Current mass health evaluation procedures, such as periodic medical examinations and the use of batteries of screening tests for asymptomatic illness will be discontinued or greatly restricted as not cost effective.
- Olsen, D.M., et al., "A Controlled Trial of Multiphasic Screening," NEJM 294:925-30 (1976).
- McKeown, Thos., "Validation of Screening Procedures in Medical Care" in Screening in Medical Care, Nuffield Prov. Hospitals Trust, London, Oxford University Press, 1968.
- Sackett, D.L. and Holland, W.W., "Controversy in the Detection of Disease," Lancet 2:357-359 (1975).

P2. REFINEMENT OF HEALTH HAZARD ASSESSMENT TECHNOLOGIES

- Health hazard assessment technologies hold promise of further refinement, taking into consideration inheritance, lifestyles, environmental and psychosocial factors, and being used to target individuals and groups for whom screening will be more cost effective, and for whom therapy will be effective if disease is detected.
- Sandusk, J. and Robbins, L. "Proposal for Health Hazard Appraisal in Comprehensive Health Care," JAMA 203:1108-1112, 1968.
- Gerbert, G. "Health: Attempt at Describing the Concept of and the Relation to Physical Capacity," Medizinische Monatsschrift (Stuttgart) 31(8):340, 1977.



### P3. MANIPULATION OF THE PHYSICAL AND SOCIAL ENVIRONMENT

- Consideration of the types of hazards that the work environment and the after work environment of Coast Guard personnel present will be a major element in the prevention of life threatening incidents.
- Feasible manipulation of the physical and social environment to reduce such hazards will be accorded due weight in management decisions regarding:
  - °Location of facilities.
  - °Numbers of personnel assigned to a given location or ship.
  - °The safety of equipment.
  - °The levels of air pollution.
  - °The availability of health hazards (tobacco, junk foods, alcohol and drugs).
  - °The availability of health maintenance resources (exercise and mental stimulation, etc.).
- Egdahl, R.H. and Walsh, D.C.(Editors), "Health Services and Health Hazards: The Employees Need to Know," Springer-Verlage 1978.
- Filstead, W.J., Rossi, J.J., Keller, M. (Editors), Alcohol and Alcohol Problems: New Thinking and Directions, Cambridge, Mass., Ballinger 1976.
- Tappan, J. R., Prevention of Alcoholism and other drinking problems in the U.S. Navy, Naval War College Advanced Research Project No. 077, Dept. of the Navy, Wash., D.C. 1973.
- Klaukka, Timo. "Positive elements of health in the measurement of disability," Unpublished, Helsinki, Finland: Social Insurance Institution, Research Institute for Social Security - filed in 1978.

P4. PSYCHOLOGICAL FACTORS (MORALE BUILDING) IN HEALTH MAINTENANCE

- More emphasis will be placed on psychological factors in health maintenance, to prevent suicide, homicide, depression, alcoholism, and accidents; morale building will be fostered as a preventive medicine factor as well as a management efficiency tool.
- Rohe, A., "Life Change and Illness Studies - Past History and Future Directions," Journal of Human Stress, March 1978, pp. 3-15.
- "Life Situation, Emotion and Disease," Psychosomatics 19:747-753 Dec. 1978.
- Tessler, Mechanic & Diamond, "Effect of Psychological Stress on Physician Utilization - A Prospective Study," Journal of Health & Social Behavior 17:353-64, (1976).
- Miller, T., Ingraham, J.G., Davidson S., "Life Events, Symptoms and Social Support," Journal of Psychosomatic Research 20:515-11 (1977).

P5. HEALTH EDUCATION EMPLOYS BEHAVIOR MODIFICATION TECHNIQUES

- Health education will be refined and targeted to maintain desired healthful behavior or to modify unhealthy behavior, and its efficacy concurrently. Behavior modification techniques will emphasize the role of the "primary group" in setting norms for healthful lifestyles as well as job satisfaction.
- Cohen, C.I. and Cohen, E.J., "Health Education Panacea, Pernicious or Pointless," (Editorial) NEJM 299:718-720 (Sept. 28, 1978).
- Dean, A., Kraft, A., Popper, B., "Primary Groups," Chapt. 7 in The Social Setting of Mental Health, Basic Books Inc., New York 1976.
- Preventive Medicine USA, "Health Promotion and Consumer Education," Produst, New York 1976.

P6. MATCHING OF INDUCTION MEDICAL EVALUATION PARAMETERS OF PERSONNEL TO BILLET REQUIREMENTS

- Induction medical evaluations will be further refined to try to match physical and mental capacities to job demands and hazards, enabling larger numbers of known handicapped and older recruits to be employed as the population continues to age and we improve our capacity both to detect more handicaps and to keep alive and functioning persons who previously would have died.
- Granger, C.U., Albrecht, G. and Hamilton, B., "Outcome of Comprehensive Medical Rehabilitation: Measurement by PULSES Profile and the Borthel Index," Arch. of Phys. Med and Rehab 60:145-153 (April 1979).

P7. NEW CONTROL MEASURES FOR COMMON VIRAL AND BACTERIAL DISEASES

- More fundamental understanding of the immune mechanisms and responses derived from cancer chemotherapy and immunosuppression for organ transplants as well as from basic immunology and pharmacology research will lead to new control measures for common viral diseases causing upper respiratory infections and bacterial diseases such as beta hemolytic streptococcal infections and gonorrhea.
- Rice, P.A., Kasper, D.L., "Characterization of Gonococcal Antigens Responsible for Induction of Bacteriocidal Antibodies in Disseminated Infection," Journal of Clinical Investigation 60:1149-58 (1977).
- Lepow, I., "Effects of Complement on Host Defense Against Neisseria," Science Vol. 205, p. 298 (July 20, 1979).
- Endo Laboratories Symmetrel (Amantadine HCl) and Influenza A Physician's Monograph (with comprehensive bibliography), pp. 64, 100 Stewart Ave., Garden City, N.Y. 11530, 1979.

P8. DECREASE IN VENEREAL DISEASE AS MORE WOMEN ENTER SERVICE

- More women in the service will decrease the number of different sexual partners of servicemen who may be infected with venereal diseases (including scabies and venereal warts) through married couples who are both in the service and being assigned to the same stations, or through unmarried sexual partners more often being both under such military controls as education in prophylaxis, early detection and treatment.

#### THERAPEUTIC AND REHABILITATIVE TECHNOLOGIES (DRUGS)

1. Availability of anti-bacterial vaccines.
2. Availability of a treatment to inhibit beta-lactamase, leaving resistant bacteria once again susceptible to penicillin.
3. Availability of vaccines against diarrhea.
4. Availability of oral agents to enhance natural secretion of insulin and/or increase number of insulin receptors.
5. Availability of vaccines to prevent juvenile-onset diabetes.
6. Availability of synthetic beta-endorphins or endorphin-inducers for analgesia.
7. Availability of oral agent to produce temporary male sterility.
8. Availability of effective agents to prevent allergic reactions.
9. Availability of effective anti-viral drugs.
10. Availability of prostaglandin-based drugs.

✓T01. AVAILABILITY OF ANTI-BACTERIAL VACCINES

- Research was largely abandoned in the 1940s when antibiotics were introduced.
- Emergence of resistant bacteria strains has led to new interest: antibiotic therapy may no longer be effective (17 percent of penicillin-treated pneumonia patients die).
- New techniques of purification of bacterial antigens and definitions of immunity in biochemical and cell-physiological terms have further aided this research.
- First such vaccine was introduced in 1978 by Merck: effective against 80 percent of pneumococci causing pneumonia. Use in splenectomized adults, persons with obstructive airway disease or sickle cell disease.
- Haemophilis influenzae (a major cause of otitis media, meningitis, and other acute life-threatening infections of children) treatment is chloramphenicol (toxic) or ampicillin (increasingly resistant). An H influenzae vaccine was recently tested in Finland during a meningococcal meningitis outbreak. Effective in older children; no protection for those under 18 months.
- In very young children new approaches may be needed: 1) immunizing during pregnancy to transfer antibodies passively until antibody-forming system is mature, or 2) altering polysaccharide antigens by combining them with more immunogenic carrier antigens.
- Meningococcal polysaccharide vaccine effective against group A and C meningococci is available but not effective in young children. Glycopeptide MDP (muramyl dipeptide) may potentiate vaccines by eliciting better antibody responses.
- Pseudomonas aeruginosa (life-threatening Gram-negative infection) vaccine prevented death in burn patients in India (vaccine given within 72 hours of burns).
- Animal studies of a vaccine to protect against legionnaire's disease suggest immunity can be produced.
- Temple University researchers have purified antigens which can be used in a vaccine against Group B streptococcus bacteria: life-threatening in young infant (causes bacteremia and meningitis). Expectant mothers would be immunized.



✓TD2. AVAILABILITY OF A TREATMENT TO INHIBIT BETA-LACTAMASE, LEAVING RESISTANT BACTERIA ONCE AGAIN SUSCEPTIBLE TO PENICILLIN

- Pfizer: synthesized inhibitor
- Beecham (UK): isolated a naturally occurring inhibitor, clavulanic acid, from streptomycetes. Patents have been granted on deoxyclavulanic acid and deoxyisoclavulanic acid and derivatives. To be marketed in early 1980s as "Augmentin." Clinical trials under way.
- Administered with penicillins

TD3. AVAILABILITY OF VACCINES AGAINST DIARRHEA

- vaccine against Escherichia coli strain which is often fatal in newborns (pregnant women would be immunized). Research at University of Pittsburgh.
- vaccine against enterotoxigenic Escherichia coli representing about 40 percent of travellers' diarrhea. Antigens have been isolated; volunteers will test the vaccine shortly. (University of Texas, Houston).

TD4. AVAILABILITY OF ORAL AGENTS TO ENHANCE NATURAL SECRETION OF INSULIN AND/OR INCREASE NUMBER OF INSULIN RECEPTORS.

- Would be used in adult-onset diabetics who still produce some insulin but are insensitive to it.
- islet-activating protein (IAP) recently developed by the Research Development Corporation (Japan) to stimulate endogenous insulin production. Dosage retains efficacy for one month, according to initial reports.

TD5. AVAILABILITY OF VACCINES TO PREVENT JUVENILE-ONSET DIABETES.

- NIH researchers reported earlier this year that reovirus type 1 infects beta (insulin-producing), alpha (glucogen-secreting), and delta (somatostatin-producing) cells in islets of Langerhans, producing a diabetes-linked condition in animals.
- Fatal diabetes linked to Coxsackie virus B<sub>4</sub> reported in May 1979.
- Some animals then develop diabetes while others do not, probably due to genetic weaknesses. Only those with susceptibility would be immunized.

/ TD6. AVAILABILITY OF SYNTHETIC BETA-ENDORPHINS OR ENDORPHIN-INDUCERS FOR ANALGESIA.

- Naturally occurring opiate peptides in the brain (endorphins or enkephalins), isolated in recent years, apparently transmit nerve information relating to pain, emotional behavior and other opiate-responsive body processes.
- Peptides readily degraded by enzymes: analogs needed to provide longer action.
- Sandoz (Basle) synthetic analog of natural methionine enkephalin (FK 33-824)
- Enkephalin derivative containing D-alanine binds to and acts at opiate receptor sites without being broken down. When injected directly into brain ventricles, powerful analgesic effect for 30 minutes.
- Potentia). In other neurotransmitter-affected areas: a sleep-inducing peptide (9 amino acids) has been isolated from the beta-endorphin chain. Also has been used in treating schizophrenia.

✓ TD7. AVAILABILITY OF ORAL AGENT TO PRODUCE TEMPORARY MALE STERILITY.

- gossypol, pigment isolated from cottonseed, undergoing clinical trials in China. Non-hormonal and inexpensive to produce.
- chlorodeoxy sugars: compounds reduce ability of sperm stored in epididymis to break down glucose and form nucleotides.
- vaccine to produce antibodies to a protein on the surface of the sperm.

TDB. AVAILABILITY OF EFFECTIVE AGENTS TO PREVENT ALLERGIC REACTIONS.

- polymerized form of ragweed antigen E (fewer local and systemic reactions, fewer injections needed to reach maintenance level)
- pentapeptide (a chain of 5 amino acids) to bind to mast cell (which releases histamine) to block allergic reaction
- orally active cromolyn compounds (mediator release inhibitors) under study at several pharmaceutical companies
- allergoids: allergens treated with formaldehyde, which decreases their ability to elicit an allergic reaction but not their antigenicity or their ability to stimulate antibody production.

✓ TD9. AVAILABILITY OF EFFECTIVE ANTI-VIRAL DRUGS

- BW248U (Zovirax, Burroughs Wellcome): several varieties of herpesvirus, approved for ocular herpes
- interferon: myelomatosis, hepatitis B, lymphoma, herpes zoster, autoimmune disorders
- Vira-A (vidarabine or adenine arabinoside, Warner-Lambert): herpes simplex, encephalitis (approved for this indication), hepatitis B; water-soluble derivatives under study.
- amantadine and rimantadine: influenza A (Amantadine approved for)
- congenital cytomegalovirus infection vaccine
- isoprinosine (inosiplex, Newport Pharmaceuticals): immunopotentiator; rhinovirus infections, herpes, varicella, influenza, measles, rubella, hepatitis, and subacute sclerosing panencephalitis
- Virazole (ICN Pharmaceuticals, ribavirin): herpes zoster, herpes genitalis, herpes stomatitis
- Pfizer's CP 20961: Interferon-inducer to stimulate nasal interferon when administered topically
- 2-deoxy-D-glucose: interferes with multiplication of genital herpes.



✓ , T010. AVAILABILITY OF PROSTAGLANDIN-BASED DRUGS

- methyl and dimethyl analogs of  $\text{PGE}_2$ : inhibit gastric acid and pepsin secretion, mucosal enhancers. More potent and longer-acting than natural PGs, oral efficacy.
- prostacyclin ( $\text{PGI}_2$ ) and  $\text{PGD}_2$ : inhibiting and preventing diarrhea caused by cholera toxin and by other PGs. Orally acting synthetic analog may be useful in: travelers' diarrhea, cholera, infantile gastroenteritis, malabsorption syndromes, inflammatory bowel disease, and drug-induced diarrhea.
- $\text{PGE}_2$  sprays: bronchodilators (CP-27-987)
- synthetic  $\text{PGF}_2$ -alpha for contraception (University of Chicago and Worcester Foundation).
- $\text{PGF}_2$  in silastic implants: when implanted in scrotal sac, decreases sperm counts to zero by causing sperm to lose motility and break apart.
- $\text{PGE}_2$ : protection against stomach irritants (aspirin, indomethacin)
- prostacyclin ( $\text{PGI}_2$ ): antihypertensive, antiplatelet, increases renal and pulmonary blood flow, bronchodilation.
- prostaglandin inhibitors (e.g., ibuprofen, naproxen) for analgesia
- $\text{PGE}_2$  and  $\text{PGF}_2$ -alpha: approved for therapeutic abortion; tablet may also induce labor at term.

#### THERAPEUTIC AND REHABILITATIVE TECHNOLOGIES (PROCEDURES)

1. Treatment with heat energy to destroy cancer tissues.
2. Use of crazy glue in combination with angiography to stop severe life threatening hemorrhage.
3. Availability of new skin grafting technique for burn treatment.
4. Availability of computer-controlled parenteral fluid dosing system for burn patients.
5. Availability of inexpensive, reliable, implantable insulin and sensor infusion systems.
6. Availability of islet implantation techniques with five or ten year duration.
7. Availability of more sophisticated implanted or transcutaneous nerve stimulation (TENS) devices to relieve pain.
8. Widespread use of reinfusion of cryopreserved bone marrow.
9. Availability of effective safe alternative female contraceptives.
10. Availability of site-specific drug delivery systems.

#### TP1. TREATMENT WITH HEAT ENERGY TO DESTROY CANCER TISSUE

- Principle - Tumor tissue is damaged considerably more readily than adjacent, normal tissue when heat is applied.
- Method - Whole body hyperthermia induced in a variety of ways.  
Local application of radiofrequency therapy.
- Applications - \*Whole body hyperthermia for widely disseminated malignancies.  
\*Local radiofrequency irradiation for:
  - sarcoma and melanomas of extremity
  - carcinomas of the urinary bladder
  - femoral neck metastasis
  - primary carcinoma of the lung
  - squamous cell cancer of head and neck
  - adenocarcinoma of the colon
  - intra-abdominal carcinoma
  - hypernephroma
- Future implications?

TP2. USE OF CRAZY GLUE IN COMBINATION WITH ANGIOGRAPHY TO STOP SEVERE LIFE  
THREATENING HEMORRHAGE

- Principle - Crazy glue seals vascular opening to prevent further blood loss.
- Method - Angiography is used to guide glue applicator to site of hemorrhage. Glue is then released there and solidifies rapidly to seal damaged vessel wall.
- Applications - Medical emergencies involving severe hemorrhage not accessible to other procedures.
- Future Implications?

TP3. AVAILABILITY OF NEW SKIN GRAFTING TECHNIQUE FOR BURN TREATMENT

- skin-graft material is pre-processed with glutaraldehyde (making it less susceptible to drying and bacterial infection); covering provides better barrier against fluid loss and infection (Yeda Research and Development Company, Israel)
- Synthetic barrier dressing (hydron hydrophilic copolymer, same material used in soft contact lenses) sprayed onto burn wound. Allows passage of certain topical antibiotics, promotes healing, and prevents dehydration. (Abbott Laboratories)
- Synthetic dressing from medical grade nylon-looped velour backed with silicone rubber. Elasticity and permeability similar to biologic skin grafts, but without rejection and sensitization. (Harvard University)
- Human amniotic membranes for early burn surface coverage. Membranes are processed with saline and water rinses, and refrigerated or frozen for future use. Cost: under \$6 per square foot, in contrast to \$25/s.q. for commercial porcine heterograft skin.
- Cow collagen with a polysaccharide base: biodegradable, nonliving material that induces growth of fibroblasts and blood vessels; may serve as a matrix for normal human epithelial cell regrowth. (Harvard Medical School and M.I.T.)

TP4. AVAILABILITY OF COMPUTER-CONTROLLED PARENTERAL FLUID DOSING SYSTEM FOR BURN PATIENTS.

- Aids in stabilization during initial 24 hours of treatment
- Digital computer adjusts I.V. solution feed based on interpretation of mean arterial blood pressure, central venous pressure, and hourly urine output.
- University of Washington

TP5. AVAILABILITY OF INEXPENSIVE, RELIABLE, IMPLANTABLE INSULIN AND SENSOR INFUSION SYSTEMS.

- poor control of blood insulin levels believed to be responsible for many diabetic complication (retinopathy, vascular disease).
- battery-powered insulin pumps worn externally now available for brittle diabetics but with no sensors.
- implantable pump with 4- to 6- month reservoir under development at Andros Inc.
- bedside "macro" model (Miles Laboratories) used in hospitals to stabilize pregnant diabetics. Automatic system monitors blood glucose and corrects imbalances by automatically pumping insulin. Sensor reliable only for 12 hours.
- Research continuing at Mayo Clinic and Joslin Clinic

TP6. AVAILABILITY OF ISLET IMPLANTATION TECHNIQUES WITH FIVE TO TEN YEAR DURATION.

- Islets of Langerhans (responsible for insulin secretion) encapsulated in polymer membranes and implanted.
- Medical College of Virginia reports in vitro and animal success (supported by Damon Corporation; animal tests continuing at Connaught Labs in Canada)
- rejection problems reported to be worse than with other human tissues; if immunotherapy is required, technique would be unattractive.
- optimal implantation or injection site still under study
- means of obtaining supply of cells may be a problem.



TP7. AVAILABILITY OF MORE SOPHISTICATED IMPLANTED OR TRANSCUTANEOUS NERVE STIMULATION (TENS) DEVICES TO RELIEVE PAIN.

- 1973 (Stanford): electrodes implanted in brain; receiver in patient's chest; inductance device placed next to receivers to cause electrical current. (Chronic, intractable pain)
- probably works by activating enkephalins.
- electrical surface stimulation now used: electrodes are placed on various surface areas of the skin.
- vulcanized silicon rubber skin surface electrodes transmit impulses through dual independent current-regulating channels to affect two separate pain areas. (Hadassah University, Israel)
- price range \$350 to \$500; most units are lightweight, portable with 2 to 4 electrodes.

TP8. WIDESPREAD USE OF REINFUSION OF CRYOPRESERVED BONE MARROW

- reduces myelosuppression associated with chemotherapy, immunodeficiency diseases, acute leukemia, and aplastic anemia.
- human cadaveric bone marrow could be banked for later transplantation (autotransplantation); marrow transplants now done with material from living donors, usually close relative.
- removing and freezing healthy bone marrow of patients in early leukemia and prior to chemotherapy; less chance of rejection (St. Vincent's Hospital, Sydney, Australia)
- cyclosporin A, an antifungal, may forestall graft-versus-host disease in bone-marrow transplants (Johns Hopkins)

TP9. AVAILABILITY OF EFFECTIVE SAFE ALTERNATIVE FEMALE CONTRACEPTIVES

- intravaginal collagen sponge with antiviral properties: blocks sperm and also spermicidal due to collagen's natural acidity. Addition of zinc provides antiviral properties, making it useful in preventing herpes simplex genitalis.
- temporary fallopian tube blockage: injections of catalyzed silicone using a hysteroscope. Silicone becomes solid within minutes. Special instrument withdraws the plugs and restores fertility. Human trials to begin shortly.
- soft vaginal ring releasing d-norgestrel
- totally bioabsorbable implantable subdermal pellet, made by fusing d-norgestrel and norethindrone with cholesterol, effective in animal studies.
- vaccines against human chorionic gonadotropin (pregnancy hormone) producing two years of contraception. (Most potential in less developed countries.)

# TP10. AVAILABILITY OF SITE-SPECIFIC DRUG DELIVERY SYSTEMS

- magnetically responsive microspheres: inoperable cancers, bacterial abscesses, reduces adverse side effects on healthy tissues.
- liposomes: drugs are injected while encapsulated in tiny oil droplets; by varying liposome size, can be steered to specific tissue sites; shape, charge, or coating can also be altered.
  - orally ingested liposomes containing insulin: insulin protected from gastric & intestinal proteolysis.
  - combined with hyperthermia: tumor region warmed by radiation to change fatty material of liposome from crystalline to liquid form, disintegrating and releasing drug in tumor area
  - encapsulated gold or hydrocortisone in liposomes directly to inflamed joints
- continuous infusion pump (self-contained) worn subcutaneously :
  - to heparinize patients with severe or recurrent clotting disorders for up to 18 months.
  - to infuse antineoplastics
  - to deliver insulin infusion
  - applications in regional vasodilation and calcium delivery for osteoporosis.
- physical delivery systems: Alza
  - Alzet, an osmotic minipump filled with a drug and implanted under the skin where it releases the fluid at a steady, controlled rate
  - Ocuser: reservoir of pilocarpine (anti-glaucoma drug) enclosed by membrane. Floats on tear film of eye--like contact lens--while drug is diffused.
- slow release of proteins from polymer matrices for up to 100 days; applications in bioassays.

#### ORGANIZATIONAL TECHNOLOGIES

1. Increasing computer applications to a variety of diagnostic activities.
2. Remote health care via telecommunications.
3. The use of physician extenders.
4. Emergency medicine recognized as a specialty.
5. Legal definition of medical profession changed and broadened to include new lifestyle subspecialties.
6. Medical services to retired persons part of standard retirement package, contingent on suitable lifestyle.
7. Large organized health service consumer groups have powerful political influence.
8. Health and survival differences between U.S. and other countries become an important international political issue.
9. Floating laboratories and emergency water treatment facilities.

01. INCREASING COMPUTER APPLICATIONS TO A VARIETY OF DIAGNOSTIC ACTIVITIES

- Computer assisted diagnosis for quality control, especially of physician extenders
- Computerized axial tomography without and with radiopaque and radioactive contrast media.
- Computerized laboratory equipment.
- "The Computed Tomography (CT or CAT) Scanner and Its Implications for Health Policy." Prepared at the request of the United States Senate Committee on Labor and Public Welfare and Committee on Finance, United States Congress, Office of Technology Assessment, Health Assessment Program, Sept. 1976.
- Creditor, Morton C., and Garrett, Julie B., "The Information Base for Diffusion of Technology: Computed Tomography Scanning," NEJM Vol 297, No. 1, pp. 49-52.
- Barnett, G. Octo, et al., "Quality Assurance Through Automated Monitoring and Concurrent Feedback Using a Computer-Based Medical Information System," Medical Care Vol. XVI #11, Nov. 1978.
- Fletcher, J. R., Capt. et al, "Computer Model for Simulation of Emergency Medical Systems," Military Medicine Vol. 144, #4, April 1979
- Kinney, T. D. and Melville, R. S., "Evaluation of Uses of Automation in the Clinical Laboratory," Clinical Chemistry 25:1351, July 1979 (Review of US DHEW Pub. (NIH) 79-501).

## 02. REMOTE HEALTH CARE VIA TELECOMMUNICATIONS.

- Telecommunication centers for relay of health care and personnel information.
- Telecommunications for viewing and directing health care from a distance, with physician extenders often providing care at the site.
- Bashshur, R. I., Armstrong, P. A. and Youssef, Z. I., Eds., "Telemedicine: Exploration in the Use of Telecommunications in Health Care," Thomas: Springfield, IL 1972.
- Rasmussen, W. I., Silva, J., "Navy Remote Medical Diagnosis System," Naval Electronics Laboratory Center, San Diego, Cal. 1976.
- Moore, G. T., et al, "Comparison of Television and Telephone for Remote Medical Consultation," NEJM 292(14):729-732.
- Wolcott, Barry W., LTC and Stieneker, 1Lt Robert E., "The Use of In-Barracks Screeners to Improve Military Sick Call," Military Medicine Vol. 144 #2, Feb. 1979
- "Telehealth Handbook," A guide to telecommunications technology for rural health care. US DHEW Publication PHS 79-3210 May 1978, pp. 153, 75 Citations, 54 projects reviewed.
- U.S. DHEW, Public Health Service HRA, NCHSR, "Computer" Based Patient Monitoring Systems," DHEW Pub. No. (HRA) 76-3143, 1976.

### 03. THE USE OF PHYSICIAN EXTENDERS

- The use of physician extenders in itself is a new technology that will be evaluated and refined, with subspecialization anticipated within the various existing categories of emergency medical technician, physician assistant, and nurse practitioner. An extender combining primary care and emergency care functions would seem most relevant to Coast Guard missions.
- U.S. Dept. of HEW, NCHSR, "Nurse Practitioner and Physician Assistants: A Research Agenda," DHEW Pub. No. (PHS) 79-3236, 1979.
- Bliss, A.A. and Cohen, E.D. (eds.), "The New Health Professionals," Germantown, Md., Aspen Systems Corp., 1977.
- Fottler, Myron D., "Physician Attitudes Towards Physician Extenders: A Comparison of Nurse Practitioners and Physician Assistants," Medical Care, Vol. XVII, No. 5, May 1979.
- Cenentano, David D., "New Health Professional Practice Patterns," Medical Care, Vol. XVI, No. 10, Oct. 1978, pp. 837-849.
- National Association of Emergency Medical Technicians, "Symposium" Emergency Medical Services System Components and the Role of the Emergency Medical Technician," The EMT Journal, Vol. 1, #1, March 1977.



04. EMERGENCY MEDICINE RECOGNIZED AS A SPECIALTY

- American Board of Emergency Medicine set up by American Board of Medical Specialties in 1979.
- Examination and subsequent certification provided for measuring competence of emergency physicians.
- Emergency Medical Technicians (and other physician extenders) training provided for measuring competence of emergency physicians.

05. LEGAL DEFINITION OF MEDICAL PROFESSION CHANGED AND BROADENED TO  
INCLUDE NEW LIFESTYLE SUBSPECIALTIES

- Legal definition of medical profession in United States changed  
to conform to international practice.
- AMA greatly weakened.

06. MEDICAL SERVICES TO RETIRED PERSONS--PART OF STANDARD PACKAGE--CONTINGENT  
ON SUITABLE LIFESTYLE

- CG does regular health and lifestyle follow-up on retired personnel

07. LARGE ORGANIZED HEALTH SERVICE CONSUMER GROUPS HAVE POWERFUL POLITICAL INFLUENCE

- Problem for Coast Guard in politicization of internal health care practices.
- Potential for demonstrations demanding improved health care quality.

08. HEALTH AND SURVIVAL DIFFERENCES BETWEEN THE UNITED STATES AND OTHER COUNTRIES BECOME IMPORTANT INTERNATIONAL POLITICAL ISSUE

- United Nations sets international health standards that may affect Coast Guard practices.

09. FLOATING LABORATORIES AND EMERGENCY WATER TREATMENT FACILITIES

- Continuous analysis capability for toxic substances.
- Application of indicated water treatment procedures.

#### SUPPORTIVE TECHNOLOGIES

1. Regimens for life-expectancy prolongation and aging retardation.
2. Compulsory periodic reexamination and relicensing of physicians, other medical and para-medical personnel.
3. Widespread dissemination of biomedical information through elementary schools, mass media, etc.
4. Drugs that enhance powers of concentration, memory, learning.
5. Delaney Amendment modified to consider balance of costs and benefits of foods and drugs.
6. Drugs that control motivation, emotion.
7. Space technology and automation make feasible prostheses by-passing neural and muscular disabilities.
8. Automated display of actuarial (frequency) data for diagnoses, etc. of cases with similar symptoms.
9. Equipment for ongoing noninvasive monitoring of normal biological processes.
10. Ongoing real time updating of all personnel medical records.

SI. REGIMENS FOR LIFE-EXPECTANCY PROLONGATION AND AGING RETARDATION

- Coast Guard must adjust daily schedules, diet, stress, etc. on personnel to reflect requirements of such regimens.
- Jobs, assignments not conducive to aging retardation or life-expectancy prolongation may require hazard pay.



S2. COMPULSORY PERIODIC REEXAMINATION AND RELICENSING OF PHYSICIANS, OTHER MEDICAL  
AND PARA-MEDICAL PERSONNEL

- Coast Guard may be exempted (a part of general exemption of government agencies)--which may attract inferior staff to Coast Guard.

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cf. Canadian Medical Association Journal.

S3. WIDESPREAD DISSEMINATION OF BIOMEDICAL INFORMATION THROUGH ELEMENTARY SCHOOLS,  
MASS MEDIA, ETC.

- Better equip public to identify and respond suitably to biomedical warning signs.
- Coast Guard may institute supplementary biomedical training for its own personnel.

S4. DRUGS THAT ENHANCE POWERS OF CONCENTRATION, MEMORY, LEARNING

- Makes possible higher work, production standards in many tasks, e.g., those requiring vigilance.

S5. DELANEY AMENDMENT MODIFIED TO CONSIDER BALANCE OF COSTS AND BENEFITS OF FOODS AND DRUGS

- Some mildly carcinogenic foods and drugs in widespread use because of important benefits, e.g., in prevention of heart disease.
- Public becomes more sophisticated about cost/benefit considerations; this includes Coast Guard personnel.

S6. DRUGS THAT CONTROL MOTIVATION, EMOTION

- Coast Guard can suppress unwanted sexuality, anger, fear.

S7. SPACE TECHNOLOGY AND AUTOMATION MAKE FEASIBLE PROSTHESES BY-PASSING NEURAL AND MUSCULAR DISABILITIES

- Totally paralyzed individuals able to move automated extensions of themselves.
- Remote control of automated extensions in hazardous (e.g., high radiation, deep sea, high temperature) environments.

S8. AUTOMATED DISPLAY OF ACTUARIAL (FREQUENCY) DATA FOR DIAGNOSIS, TREATMENT, OUTCOMES, ETC. OF CASES WITH SIMILAR PRESENTING SYMPTOMS AND BACKGROUNDS AS ANY GIVEN CASE

- By-product of automation of medical records.
- Provides legal definition of "orthodox" vs. "unorthodox" treatment.
- Jerrold Maxmen, Albert Einstein College of Medicine, sees computer actually going on to make the diagnosis, recommend treatment.

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cf. The Post-Physician Era; Medicine in the Twenty-First Century  
(New York: John Wiley & Sons, 1976).

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S10. ONGOING REAL TIME UPDATING OF ALL PERSONNEL MEDICAL RECORDS (PRESCRIPTIONS, DIAGNOSES, EPISODES, ETC.) IN AUTOMATED DATA BASES AVAILABLE FOR INSTANT DISPLAY

- Part of automation of complete personnel record system.
- Records kept in distributed network to minimize vulnerability to sabotage, tampering, etc.

S9. EQUIPMENT FOR ONGOING, NONINVASIVE MONITORING OF NORMAL BIOLOGICAL PROCESSES,  
SUCH AS KIDNEY FUNCTIONING, HORMONE SECRETION, BLOOD FLOW

- Persons who can watch displays of their own bodily processes must be taught not to overreact, create dangerous oscillations.

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